Enraf Nonius

Radarmed 650

SERVICE MANUAL

Part number: 1409773

Radarmed 650

SERVICE MANUAL

Copyright:

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part number: 1409.773-40

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1 INTRODUCTION

1.1 INTRODUCTORY REMARKS

This manual has been written for the technicians involved in the service of the Radarmed 650. Service can be carried out by the service organization of the supplier or by any other technician authorized by Enraf-Nonius B.V.

The manufacturer will not be held responsible for the results of maintenance or repairs by unauthorized persons.
Enraf-Nonius B.V. is further referred to as Enraf-Nonius

1.1.1 Safety Aspects

Safe execution of the procedures in this manual requires technical experience and general knowledge of safety precautions.

Warnings, Cautions and Notes have been used throughout the manual to bring special matters to the immediate attention of the reader.

- The **Warning** concerns danger to the safety of the technician or user;
- The **Caution** draws attention to an action which may damage the equipment;
- The **Note** points out a statement deserving more emphasis than the general text, but which does not deserve a Warning or Caution.

Warning: Inside the Radarmed 650 high voltages are available, beware of electrical shock. Do not touch components or heat sinks when the cover is removed.

The sequence of steps in a procedure may also be important from the point of view of personal safety and prevention of damage, therefore never change the sequence of procedural steps or alter a procedure.

1.1.2 Legal Aspects

This manual and the information herein are copyright property of Enraf-Nonius B.V. (Delft, The Netherlands).

Enraf-Nonius B.V. disclaims any responsibility for personal injury and/or damage to equipment caused by:

- Negligence or disregard of a Warning or Caution;
- Deviation from any of the prescribed procedures;
- Execution or activities which are not prescribed;
- Ignorance of the general safety precautions for handling tools and the use of electricity;
- Repairs and/or adjustments made to the equipment with a patient connected.

1.1.3 Environmental Aspects

The following materials have been used for construction of the Radarmed 650:

- material: PMMA Front plate,

- material: Beryllium oxide (is toxic, this is found inside the power transistors, do not open the transistor housing).

Please dispose off properly in case of replacement according to the local regulations.

1.1.4 Data registration

1.1.4.1 Equipment and customer registration/Service file

From the point of view of safety and product liability the following data must be registered for each unit:

- Equipment data: Type (part) and serial number
- Customer data: Date of delivery of the equipment to the customer, name and full address of the customer
- Configuration file: The actual configuration data of the equipment.
- Service file: Data of all service activities

The distributor as well as their dealer and/or service organization if any, is responsible for these records. They must be able to provide these data when requested.

1.1.4.2 Configuration file

A configuration file gives the serial numbers and/or batch numbers of main sub-assemblies and/or important parts per unit. The parts listed in a configuration file are defined as registered parts. Such are for example parts as transformers, PC Boards, key-boards and software. The registered parts of the Radarmed 650 are marked with a "Y" for "Yes" in the spare parts list in appendix A (column C).

Enraf-Nonius has the original configuration file of each unit. Any possible changes in the original configuration of the supplied units must be filed and the distributor must be able to provide this data. These changes can simply be stored in the service file of the specific unit. Part, serial or batch number(s) of the new parts have to be mentioned.

In case of a claim we expect the distributor to report the claim and the actual configuration data of the equipment in question.

1.1.5 Product documentation

The documentation set for the Radarmed 650 also includes an Instruction manual and a therapy book. The instruction manual is a recommended item for all service engineers.

Ordering data:

- 1409.754 Instruction manual
- 1409.773 Service manual

1.1.6 Installation

For installation of the Radarmed 650 see the Operating Instruction manual.

- It is not allowed to use this unit in so-called "wet rooms" (hydrotherapy rooms).
- The mains supply connections must comply with the national requirements regarding medical used rooms.
- Before connection of this apparatus to the mains supply, check that the mains voltage and frequency stated on the type plate of this apparatus correspond to that of the mains supply. The 220-240V model is intended for nominal mains voltages of 220, 230 or 240 volt.
- This apparatus must only be connected to a wall socket with protective earth connection.
- A potential equalisation cable may be connected to this unit if prescribed in the national regulations.

1.1.7 **Modifications**

This publication could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be published as Service Info's in appendix C of this Service Manual.

1.1.8 **Product evaluation**

In order to continuously improve the quality of our products, Enraf-Nonius requests her service organizations to report any structural problem which may be discovered. When the same problem regularly occurs or when safety problems occur, we would like you to send us a product complaint report. The report must contain the name, the type of the product, a detailed description of the problem, the number of the same problems, quantity of sold equipment and your solution to the problem (if any). The product complaint report can be found as an enclosure in the Service Reference book.

1.1.9 **Additional Information**

Please do not hesitate to contact your National sales organisation or distributor.

For additional information:

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2600 AV Delft
The Netherlands

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1.2 **GENERAL**

The Radarmed 650 Microwave Therapy Unit operates on a wavelength of 12 cm (2450 MHZ). The great advantage of microwave treatment lies in the safety of its intensity setting, which is made according to the patient's sensation of warmth.

The appliance is equipped with an operating safety circuit, which requires the intensity control to be set to zero before any treatment can be commenced. Should the H.F. plug be inadvertently withdrawn during treatment, the intensity is automatically set to zero immediately, and the operating sequence must be recommenced.

The intensity can be adjusted step-less from about 5 to 150 watts and is shown on the LED output power at the front panel meter to assist the operator.

The Radarmed 650 is suitable for use with the circular-field, through emitter and longitudinal-field emitters.

Certain minimum distances from the surface of the body must be maintained with different emitters.

- Circular-field emitter	approx. 10 cm
- Longitudinal-field emitter	approx. 5 cm
- Through emitter	0 cm

The required distance for the through emitter is determined by the internal design.

Circular-field emitter
The circular-field emitter can be used on restricted body areas to effect deeper penetration. It is the most universal, and therefore the most used, emitter.

Longitudinal-field emitter
The longitudinal-field emitter is used to treat long parts of the body, such as limbs.

Through emitter
The through emitter is used to treat large areas. The special form of this emitter is well adapted to the appropriate body contours. Restricted regions, such as the shoulder and knee joints, can likewise be advantageously treated with this emitter, as can large muscular areas such as the pectoral girdle. For reasons of hygiene, a cloth should always be placed between the patient and emitter.

The Radarmed 650 has been designed and manufactured to ensure the highest level of safety; the unit fully complies with the IEC 601-1 (general standard), IEC 601-2-6 (microwave equipment) and IEC 601-1-2 (EMC) standards.

1.3 TECHNICAL DATA

1.3.1 General

Mains supply	: 230 VAC	
Permissible mains voltage var.	: ±10%	
Mains frequency	: 50-60 Hz	
Current consumption	: max. 3.5 A at 230 V	
Mains fuses	: 2 x T 6.3 H 250 V	
Internal fuses	: T 0.315 A	(F103)
	: T 0.5 A	(F104)
	: T 0.2 A	(F105)
	: T 1 A	(F106)
Patient leakage current	: typical < 10 µA	(IEC requirement ≤ 100 µA*)
Ditto, single fault condition	: typical < 10 µA	(IEC requirement ≤ 500 µA*)
Earth leakage current	: typical 250 µA	(IEC requirement ≤ 500 µA*)
Ditto, single fault condition	: typical 500 µA	(IEC requirement ≤ 1000 µA*)
Earth resistance	: 0.06 Ω (typical)	(IEC601 requirement ≤ 0.2 Ω)

Safety class	: I [1] type, B [2]
Safety approval	: GS Test Mark of TÜV Rheinland [3]
Radio interference suppression	: IEC 601-1-2 EN55011 Group2 Class B EN50082-2
Dimensions	: 39 x 40 x 93 cm
Weight	: 50 kg (excluding arm)
Colour specification	: EN Custom colours

*) During measuring of the patient leakage current (normal or single fault condition) and earth leakage current (normal or single fault condition) no H.F. output is generated

1) I: The equipment has a safety earth (ground) connection, and must be connected to a wall socket with protective earth connection.

2) B: Equipment providing a particular degree of protection against electric shock according to IEC 601-1 and IEC 601-2-6 safety standards.

3) Copies of certificates or certificates of conformity (COC) are available on request.

1.3.2 **European union:**

Marking : CE [4]

CE 0197

4) This equipment complies with all requirements of the EMC Directive (89/336/EEG and 92/31/EEG) using the transition period for the Medical Device Directive (93/42/EEG).

1.3.3 **High frequency therapy**

Operating frequency	: 2450 MHZ ± 50 MHZ
Channels	: 1
Mode of operation	: Continuous
High-freq. output power	: Continuous H.F. max. 150 W at emitter
Power indicator	: LED at front panel up to 150 W
Timer (mechanic)	: 0 - 30 min.; with acoustic signal and switch-off

2 DESCRIPTION

Because of the modular construction of the Radarmed 650 the description is on block diagram level.

2.1 **BLOCK DIAGRAM** (see appendix B fig. 1)

The electronic circuit of the Radarmed 650 is located on 5 modules:

- Display module (also referred to as display PC Board).
- Display interface module (also referred to as display interface PC Board).
- Application module (also referred to as output stage PC Board).
- Distributor module (also referred to as distributor PC Board).
- H.F. output module (also referred to as magnetron).

2.1.1 **Display module** (display PC Board)

The display module displays the H.F. output of the Radarmed 650 unit. The signal used for measuring the H.F. output is fed into the display PC Board via the display interface PC Board. The display PC Board is a three digit LED DC Voltmeter with an maximum resolution of 1mV.

2.1.2 **Display interface module** (display interface PC Board)

The display module adapts the anode voltage measured at resistors R125 / R126 on the main PC Board. Both resistors are parallel mounted in the anode circuit of the magnetron. The measured voltage is related to the current which flows through the magnetron and therefore also related to the output power.

2.1.3 **Application module** (main PC Board)

The function of the application module is to generate the output power to drive the magnetron.

The application module comprises the following circuits:

- Power supply circuits.
- Fuses.
- Output stages

Description of the application module:

The mains power is fed into the Radarmed 650 via a mains entrance. Inside the mains entrance two mains fuses are found. The mains power runs via a mains filter and a mains switch to the power supply PC Board. As soon as the equipment is switched on the fan starts to run and the magnetron is heated. The mains supply is fed via the mains configuration strip CNA (used for setting the magnetron heater voltage to 3.4V, see par. 4.6.1) into the primary side of the mains transformer TR1. The mains power is transformed into 3.4V (magnetron heater), 8.8V, +/- 9.7V and fed into the power supply section of the main PC Board.

For details and measuring points see appendix B figures 10, 11 and 12.

The high voltage required for the magnetron is supplied by transformer TR2 (see app. B fig. 10). The H.F. power is controlled via the output power control resistor R1, resistors R2 and R3 series circuit which are switched as a voltage divider.
When the output power control resistor is turned in clockwise direction the resistance is decreasing and the output voltage at transformer TR2 is increasing. Capacitor C1 is charged via the diode on the distributor PC Board during the half of the mains period corresponding to the selected dosage (voltage).

2.1.5 **Distributor module** (distributor PC Board).

The function of the distributor module is to select and distribute the high voltage required for the magnetron supplied by the high voltage transformer TR2.

Description of the distributor module:

The secondary voltage of TR2 which is supplied to the distributor module can be switched by different combinations of connecting the wire. Connecting the wire (combinations will result in the following voltages:

- CN3 to CN2 (1900VAC),
- CN6 (2000VAC),
- CN3 to CN11 and a connection from CN2 to CN8 (2100VAC),
- CN3 to CN11 and a connection from CN6 to CN8 (2200VAC).

These connections are used for rough setting of the maximum output power see app. B fig. 7. For adjustment of the secondary voltage (output power adjustment) see par. 4.6.2.

2.1.6 **H.F. output module** (magnetron)

The function of the magnetron is to generate the H.F. output with a fixed frequency of 2450MHz (± 50 MHz). The H.F. output is depending on two parameters:

- the charge of the buffer capacitor,

- the output voltage of the high voltage transformer TR2 (for schematic diagram see appendix B fig. 10).

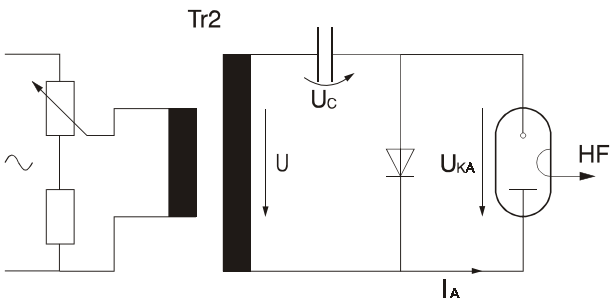


Figure A. Principle drawing of the magnetron control circuit.

At the positive period of the power supply transformer TR2, capacitor C1 will be charged. The charge (Q) of the capacitors depends on the setting of the output power control.
At the negative period the transformer supply voltage and the capacitor voltage are series

connected and therefore added. At a voltage of ± -2.6kV the magnetron ignites, an anode current will flow and H.F. energy is emitted. The capacitor C1 will discharge. When the voltage exceeds -2.6kV the magnetron cuts-off.

The emitted H.F. power is also depending on the hight of the supplied high voltage at transformer TR2. The higher the voltage at the secondary side of TR2, the higher the voltage on the capacitor C1 and at the magnetron. The current which flows through the magnetron is in relation with the H.F. emitted energy, during the time that the magnetron is ignited.

The output of the magnetron is connected to a H.F. filter. The directly heated cathode is connected to the secondary winding of transformer TR1. When H.F. energy is emitted high voltage is available at the heater connections of the magnetron with respect to ground (DANGER HIGH VOLTAGE !!).

3 TEST EQUIPMENT AND TOOLS

3.1 TEST EQUIPMENT

For the repair and maintenance procedures of the Radarmed 650 the following test equipment and accessories are required:

- Digital multimeter 3 ½ digit, accuracy better than 1 %. For example Fluke 77
- Safety tester according IEC 601-1. For example a Rigel Safety tester, model 233

3.2 TOOLS AND MATERIALS

It is assumed that a complete set of precision engineering tools is available. For the service of the Radarmed 650 the following additional tools are required:

- Anti-static bench mat with earthing wire and wrist strap
- Tool for removal of Dual In Line (DIL) integrated circuits, 0.6"

For output power adjustment:

- moving-coil milliammeter (100mA) in the DC range
- Large 150W H.F. emitter

Warning: The use of a oscilloscope is **PROHIBITED** because the earthing of the oscilloscope and the earthing of the Radarmed 650 will cause a short-circuit.

4 MAINTENANCE

4.1 GENERAL

We recommend to check the Radarmed 650 annually.

4.2 CHECKLIST

The following procedures must be carried out during an inspection and/or after every repair:

4.2.1 Modifications, if any, according to the "Service Info" sheets. See appendix C of this manual for further information.

4.2.2 Visual inspection. Check the electrical wiring for safety and check that all components are properly fastened. Check that the fuses have the specified ratings (see par. 1.3.1).

4.2.3 Check that all accessories are in good condition.

4.2.4 Functional test (see chapter 4.3).

4.2.5 File all service activities.

4.3 FUNCTIONAL TEST

4.3.1 Fan and display test

Connect the Radarmed 650 to the mains and switch on the equipment, the fan starts to run. Check that the fan runs without rattling. Also check the air-flow is correct, the air is blown threw the magnetron and that the air-intake is free. Check that the three-segment LED output power display will light (display shows “000").

Switch off the unit.

4.3.2 Treatment timer

Connect a large (150 Watt) H.F. emitter to the Radarmed 650. Switch on the unit and set a treatment time with the mechanical treatment timer. Turn the output power control fully anti-clockwise turn the output control clockwise until the output power display reads “150" (Watt). Check that at the end of the treatment time the H.F. output switches off and the end of treatment signal heard. The output power display will show “000".

Switch off the unit.

4.3.3 H.F. emitter detection circuit

Connect a large (150 watt) emitter to the unit. Set treatment time (for example 5 min.) and start a treatment. Check that there is H.F. output. Stop the treatment by turning the output power control to zero. Disconnect the H.F. emitter cable from the unit (output impedance ∞). Turn the output power control clockwise and check the output power. Increasing the output power control will **not** result in increasing the H.F. output signal (display shows “000"), no

H.F. energy is emitted.

4.3.4 Magnetron Heater Voltage

See par. 4.5.2 for removal of the front cover.

Warning: Do **NOT** set the treatment time and/or start a treatment. When a treatment is started high voltage **(!! 2000 V. with respect to ground !!)** is applied to the cathode of the magnetron.

Switch on the Radarmed 650 unit. Check the mains voltage at the mains distributor strip CNA (see appendix B fig. 11) between the white wire at connection CNA-1 and the purple wire at CNA-2, CNA-3 or CNA-4 and check that the mains voltage is 230 V ±1 V / 50 Hz. Measure the heater voltage directly at the magnetron at the two blue leads. The measured voltage must be between 3.37 V and 3.43 V.
If the heater voltage is incorrect see par. 4.6.1.

Switch off the unit.

4.3.5 Supply voltage tests

Switch on the Radarmed 650 unit. Check the supply voltages, connect a multimeter with the negative testing lead to ST168 (ground terminal) at the main PC Board (see appendix B, fig. 6).

Connect the positive testing lead to T101 +12VDC (see appendix B fig. 6)
Connect the positive testing lead to T102 + 5VDC (see appendix B fig. 6)
Switch off the unit.

4.3.6 Safety tests

Check the resistance of the earth connection (see technical data).
Check the earth leakage current in normal condition (N.C.) as well as in the single fault condition (S.F.C.) (see technical data).

4.4 TROUBLE SHOOTING

4.4.1 Trouble shooting list

	Failure indication:	**Action to be taken:**
4.4.1.1	Radarmed 650 does not switch on; LED displays fail to light, fan does not work	1. Check mains power supply 2. Check/replace mains cable 3. Check/replace mains fuses (mains entrance) 4. Check/replace mains switch 5. Check/replace main PC Board fuses 6. Check/replace wiring 7. Check/replace transformer (TR1)
4.4.1.2	Fan works, display fails to light	1. Check/replace main PC Board fuses F104 / F015 /F016

		2. Check power supply PC Board voltages see par. 4.3.5 3. Check/replace wiring 4. Check/replace display PC Board 5. Check/replace main PC Board
4.4.1.3	Fan does not start, display OK	1. Check/replace fuse F103 2. Check/replace fan
4.4.1.4	No H.F. output	1. Check/replace H.F. Cable 2. Check/replace emitter 3. Check/replace main PC Board 4. Check/replace treatment timer 5. Check/replace power output control (R1) 6. Check/replace magnetron/filter assy. 7. Check/replace transformer (TR2)
4.4.1.5	Safety test fails	1. Check/replace wiring 2. Check/replace transformer 3. Replace main PC Board

4.5 REPLACEMENT PROCEDURES

4.5.1 General

When handling static sensitive devices such as the PC Boards of the Radarmed 650 the following precautions should be observed:

- Persons should be earthed by means of a wrist strap
- Ground all electrical equipment, work-bench, soldering iron etc.

After every repair a functional test must be performed (see par. 4.3).

Warning: Inside the Radarmed 650 high voltages are available, beware of electrical shock. Do not touch components or heat sinks when the cover is removed.

4.5.2 Front cover

Removal: Switch off the unit and remove the mains cable from the mains entrance. Remove the screws on both sides of the metal strip between top- and front cover. Remove the metal strip. Remove the two screws of the front cover. Remove the front cover by lifting it from the chassis.

Installation: Installation of the front cover is in reverse order of the removal procedure.

4.5.3 Top cover

Removal: Remove the front cover (see par. 4.5.2). Remove the four screws at the top at the inside of the housing. Lift the top cover carefully, and put it carefully with the rear side-down on the chassis and disconnect the mains switch if

necessary. Disconnect the cables from the display PC Board, output power control and the treatment timer. Remove the top cover.

Installation: Installation of the top cover is in reverse order of the removal procedure.

4.5.4 **Main PC Board**

Removal: See par. 4.5.2 for removal of the front cover. Remove the wiring from connectors ST103, ST107, ST108, ST109, ST110, ST118, ST124, ST128, ST150, ST164, ST165 and ST168. Remove the display interface PC Board and disconnect the wires from the measuring resistor (R26). Remove the mounting screws and carefully remove the main PC Board. Disconnect the display PC Board power supply wires from the main PC Board (T102).

Installation: Installation of the main PC Board is in reverse order of the removal procedure. For wiring details see Appendix B, fig. 6 and fig. 10.

4.5.5 **Display PC Board**

Removal: See par. 4.5.2 for removal of the front cover and par. 4.5.3 for opening the top cover. Disconnect the cable from CN1(see appendix B fig. 8). Remove the top mounting screw and remove the display PC Board.

Installation: Installation of the display PC Board is in reverse order of the removal procedure.

4.5.6 **Output power control potentiometer** (R1)

Removal: See par. 4.5.2 for removal of the front cover, and par. 4.5.3 for removal of the top cover. Remove the output power control knob by pulling off the cover and loosening the mounting nut. Remove the output power control potentiometer assembly

Installation: Installation of the output power control potentiometer is in reverse order of the removal procedure. For wiring details see Appendix B, fig. 10.

4.5.7 **Distributor PC Board**

Removal: See par. 4.5.2 for removal of the front cover. Remove the wiring from connectors CN1 threw CN13. Remove the three screws at the chassis and remove the distributor PC Board.

Installation: Installation of the distributor PC Board is in reverse order of the removal procedure. For wiring details see Appendix B, fig. 7 and fig. 10.

4.5.8 **Magnetron / H.F. filter assembly**

Removal: See par. 4.5.2 for removal of the front cover. Remove the magnetron heater and the High-Voltage wiring (lower connection of the magnetron unit). Remove the wiring from the thermal switch. Unsolder the wire from the H.F. filter. Remove the four screws from the chassis. Remove the magnetron / H.F. filter assembly.

Installation: Installation of the magnetron / filter assy. is in reverse order of the removal procedure. For wiring details see Appendix B, fig. 10.

Note: The magnetron / H.F. combination can only be replaced as an assembly. The magnetron / H.F. assembly parameters are factory determined. These parameters are required for correct H.F. output power adjustment.

See par. 4.6.1 and 4.6.2 for adjustment of the magnetron / filter assy.

4.5.11 **Mains transformer** (TR1)

Removal: See par. 4.5.2 for removal of the front cover. Remove the primary wiring from the mains distribution strip (CNA). Remove the magnetron heater wire supply from the magnetron. Remove the secondary wiring from the main PC Board. Remove the four mounting screws.

Installation: Installation of the mains transformer is in reverse order of the removal procedure. For wiring details see Appendix B, fig. 10.

4.5.12 **High-Voltage transformer** (TR2)

Removal: See par. 4.5.2 for removal of the front cover. Remove the high-voltage wiring from the distributor PC Board. Remove the primary wiring from connector ST171(main PC Board)and from resistor R2. Remove the four mounting screws.

Caution: Be careful when removing the high-voltage transformer. When an emitter is connected to the Radarmed 650 the unit could be tilted backwards.

Installation: Installation of the high-voltage transformer is in reverse order of the removal procedure. For wiring details see Appendix B, fig. 10.

4.5.13 **Cooling fan**

Removal: See par. 4.5.2 for removal of the front cover. See par. 4.5.11 for removal of the mains transformer. See par. 4.5.12 for removal of the high-voltage transformer. Remove the wiring from the motor. Remove the four mounting screws.

Installation: Installation of the cooling fan is in reverse order of the removal procedure. For wiring details see Appendix B, fig. 10.

4.6 **ADJUSTMENT PROCEDURES**

The adjustment procedure for the Radarmed 650 is carried out under the following test conditions:

- The mains voltage must correspond with the technical specifications of the Radarmed 650
- The ambient temperature must be 25° C ± 5° C

To perform the adjustment procedures of the Radarmed 650 open the housing as described

in par. 4.5.2.

4.6.1 **Magnetron heater voltage adjustment**

Switch on the Radarmed 650 unit. Check the mains voltage at the mains distributor strip CNA (see appendix B fig. 11) between the white wire at connection CNA-1 and the purple wire at CNA-2, CNA-3 or CNA-4 and check that the mains voltage is 230V ±1V / 50Hz.
Measure the heater voltage directly at the magnetron at the two blue leads. The measured voltage must be between 3.37V. and 3.43V.

Warning: Do **NOT** set the treatment time and/or start a treatment. When a treatment is started high voltage (**!! 2000V. with respect to ground !!**) is applied to the cathode of the magnetron (High-Voltage connection is the blue wire connected to PCB2 - CN4).

If the heater voltage is to low, shift the purple wire to the next higher connection at CNA (fig. 11), for example: shift the purple wire from CNA-3 to CNA-2.
Shifting the purple wire from CNA-4 to CNA-3 or CNA-2 will increase the heater voltage.

If the heater voltage is to high, shift the purple wire to the next lower connection at CNA (fig. 11), for example: shift the purple wire from CNA-3 to CNA-4.
Shifting the purple wire from CNA-2 to CNA-3 or CNA-4 will decrease the heater voltage.

4.6.2. **H.F. output power adjustment** (using a moving-coil milliammeter in the DC range)

Warning: Be careful, high voltage (**!! 2000V with respect to ground !!**) is present during the anode current adjustment.

The following power adjustment refers to the use of a moving-coil milliammeter in the DC range and a large (150 W) emitter for the 100 W adjustment.
On the magnetron / H.F. filter assembly the anode current of the different output power ranges (100W. and 10W.) are found. These values are valid for the magnetron / H.F. filter assembly in question. These values are factory determined and are measured in the high voltage cathode lead which is connected to CN4 at the distributor PC Board (see appendix B, fig. 7).
If no emitter is connected ® → ∞) "000" appears in the output power display and the appliance cannot be started.

Connect a large emitter to the output connector of the unit.
Plug the voltage selector jumper CN3 (distributor PC Board) onto CN6 high-voltage tapping.

Connect the moving-coil milliammeter in the cathode lead at connector CN4 at the distributor PC Board. Using a mains voltage of 230V. / 50Hz, turn the output power control fully anti-clockwise and than clockwise until the H.F. output power display reads “100".
Check that the current value read on the milliammeter correspondents to the value which is found on the magnetron/filter assembly for 100 Watts H.F. output power.

If the value is not correct find the nearest value by changing the high voltage supply by making one of the following combinations on the distributor PC Board:

Connect	CN3	to	CN2						supply voltage: 1900V.
Connect	CN3	to	CN6						supply voltage: 2000V.
Connect	CN2	to	CN8	and	CN3	to	CN11		supply voltage: 2100V.
Connect	CN6	to	CN8	and	CN3	to	CN11		supply voltage: 2200V.

These connections are used for rough setting of the maximum output power

If the output power level is not reached, plug the voltage selector jumper onto the next highest high-voltage tapping (see above), **switch off the H.F. power first !!!.**

If the output power level is exceeded, plug the voltage selector jumper onto the next lower high-voltage tapping (see above), **switch off the H.F. power first !!!.**

When the nearest value is found the current can be fine-adjusted by means of adjusting resistor R2. Fine-adjustment is done by moving the slide over the wire wound resistor. Before moving the slide loosen the screw which fixes the slide to the resistor.

Note: When adjusting resistor R2 the slide must be at least ¾ to the left of the total length of the resistor body.

Warning: Be careful, high voltage (**!! 230V with respect to ground !!**) is present at the slide of the resistor.

Set the unit to maximal H.F. output power and check that the unit reaches maximal power (150 W). If the unit does not reach the maximum output power, readjust the unit as above.

The adjustment is now completed, switch off the equipment.

5 STORAGE AND TRANSPORT

This chapter contains information about the storage and transport of the Radarmed 650 and the storage conditions for the spare parts.

5.1 STORAGE

The Radarmed 650 and any accessories must always be stored in their original packing.

The long term storage conditions are:

- The unit must be stored at room temperature (± 20 °C).
- The relative humidity should be less than 50%.
- The storage room must be clean, dust-free and ventilated.

For the spare parts of the Radarmed 650 the above mentioned requirements also apply.

5.2 TRANSPORT

The Radarmed 650 and any accessories should always be transported in its original packing. This packing withstands normal shocks and vibration caused by transport.

During transport and short term storage the temperature should be between - 40 °C and + 70 °C. The absolute temperature is not too important, however, rapid fluctuations in temperature must be avoided.

6 SPARE PARTS

This chapter deals with placing orders for spare parts (refer to appendix A) as well as the listing of the actual spare parts (appendix A, spare parts list).

6.1 ORDERING

Spare parts can only be ordered if the following data is supplied:

- Part number
- Description
- Quantity
- Shipping details (Incoterms); normal or rapid delivery

The required data is mentioned in appendix A. For the actual spare parts programme please refer to in the spare parts catalogue which is published every year.

Enraf-Nonius only supplies parts mentioned in appendix A. Standard parts such as screws, nuts, cleaning agents and the like are not supplied by Enraf-Nonius; these parts must be purchased locally.

Send your order to your contact person at the sales department of Enraf-Nonius After receipt of an order you will receive a confirmation. Always check the ordering data.

6.1.1 Normal delivery

The procedure for 'normal delivery' is the standard procedure for processing your spare parts orders. This procedure is suitable for spare parts orders which do not require rapid delivery such as stock replenishment orders

If you have an agreement with Enraf-Nonius about fixed delivery dates, the spare parts will be send together with the next delivery unless otherwise agreed.

6.1.2 Rapid delivery (by DHL-courier)

If spare parts for an urgent customer repair are not on local stock then rapid delivery can be requested from Enraf-Nonius The DHL-costs will be charged. Note that rapid delivery is subject to stock availability.

6.1.3 Ordering PC Boards

Printed circuit boards are only obtainable as spare part in their latest version. Consult the technical documentation for instructions of how to modify the latest version of the PC Board for use in older versions of the apparatus.

6.2 WARRANTEE CLAIMS

Warrantee claims must be provided with the Enraf-Nonius-invoice number and with the type and serial number of the equipment in question. Enraf-Nonius may ask you to return the (defective) spare parts.

6.3 REPAIR SERVICE

Defective PC Boards can be offered to Enraf-Nonius for repair. The repair order can be presented to Enraf-Nonius by means of the "Authorization Request for Return Shipment". Refer to the return shipment procedure as per par. 6.4.

6.4 RETURN SHIPMENTS

To return defective equipment and/or spare parts an authorization of Enraf-Nonius is required. To get an authorization use the "Authorization Request for Return Shipment" of which a copy can be found in the Service General Information guide.

The procedure is as follows:

1. Fill in the "Authorization Request for Return Shipment" form and send this form by fax to your agent at Enraf-Nonius

2. Within two working days you will receive the form back again by fax. You will then see that the R(eturn) number has been filled in; this means that your return shipment has been registered by Enraf-Nonius

3. Note this R(eturn) number on the address label. Pack up the goods together with the "Authorization Request for Return Shipment" form (or a photo copy).

After the repair order has been carried out the goods will be returned as soon as possible.

If you have an agreement with Enraf-Nonius about fixed delivery dates, the repaired goods will be send together with the next delivery.

APPENDIX A **SPARE PARTS LIST**

The spare parts list on the next page shows all available spare parts.
The various columns are explained hereafter:

Item:	The item number refers to the number on the illustration(s).
R1:	A number in this column indicates a suggested quantity of spare parts for users (Quantity of equipment in use: 1 - 3).
R2:	A number in this column indicates the minimum recommended quantity for spare parts stock at the local service organization (Quantity of equipment in use: 1 - 50).
C:	A "Y"(yes) in this column marks the so-called "Registered" items. The service engineer must record the type and serial number of the spare part as well as type and serial number of the unit in case of replacement.
Part no.:	The part number column shows the code for ordering the part from Enraf-Nonius.
Description 1:	This column gives the general description of the spare part.
Description 2:	This column gives the technical specification of the spare part.

Spare parts list

Item	C	R1	R2	Part no.	Description1	Description2
001	Y	0	1	0409818	Magnetron assy,	compl. with H.F. filter
002		0	1	0409817	Fan,	for, magnetron
003		0	2	2188063	Castor	
004		0	2	2188064	Castor,	with brake
005		0	0	2994805	Knob,	with indication
006		0	0	2994806	Spacer,	felt for knob (item 007)44x3mm
CN		0	1	2523962	Connector,	mains input, fused
C1		0	1	3492293	Capacitor,	C900N MCFPO 490, paper
F1/F2		10	10	2655027	Fuse,	F 6.3A, H, 250V, 5X20mm for 230/240V version
F103		10	10	2655170	Fuse,	T 0.315A, 250V, 5X20mm
F104		10	10	2655172	Fuse,	T 0.5A, 250V, 5X20mm
F105		10	10	2655168	Fuse,	T 0.2A, 250V, 5X20mm
F106		10	10	2655175	Fuse,	T 1A, 250V, 5X20mm
FL		0	0	2670079	Filter,	mains, Schaffner FN332-6/05
PCB1	Y	0	2	0409809	PC Board,	main
PCB2	Y	0	2	0409814	PC Board,	distributor
PCB3	Y	0	2	2611120	PC Board,	display (meter)
PCB4	Y	0	2	0409681	PC Board,	display interface
R1		0	1	2639152	Pot.meter,	360 Ω, 10%, lin.
R2		0	1	3492219	Resistor,	15 Ω, 10%, wirewound
R3		0	1	3492220	Resistor,	510 Ω, 10%, wirewound
S1		0	2	2601488	Switch,	mains, 2pole, 16A 250V
S2		0	1	2619077	Switch,	timer, 30min.
S th		0	0	3492300	Switch,	thermal cut-out (auto reset)
TR1	Y	0	0	2680682	Transformer,	220 / 0-200-1900-2000V
TR2	Y	0	0	2680680	Transformer,	230 / 0-9.7-8.8-3.4V

APPENDIX B **DRAWINGS**

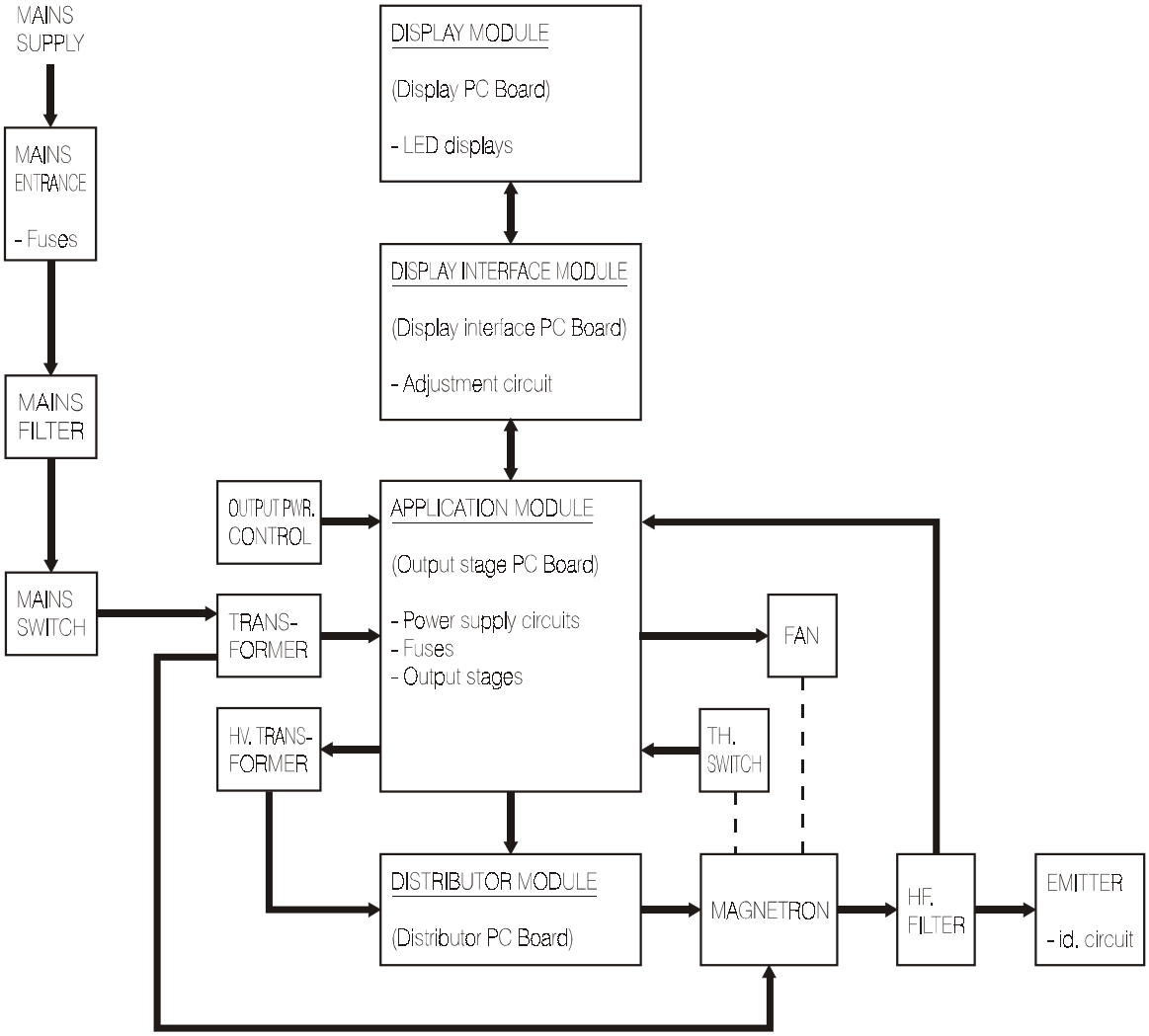


Figure 1 Block diagram

Figure 2 Radarmed 650 top view.

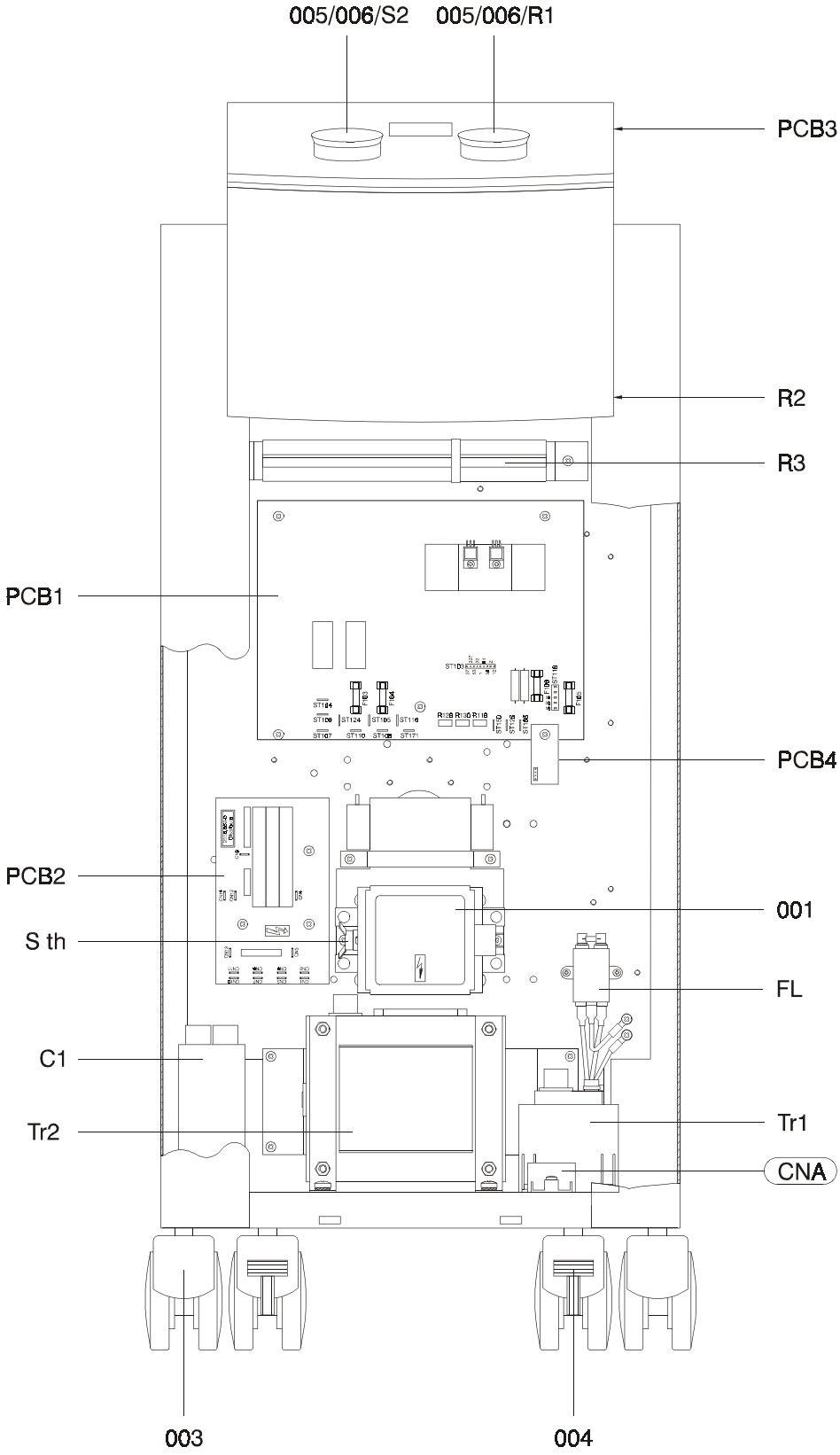


Figure 3 Chassis front view.

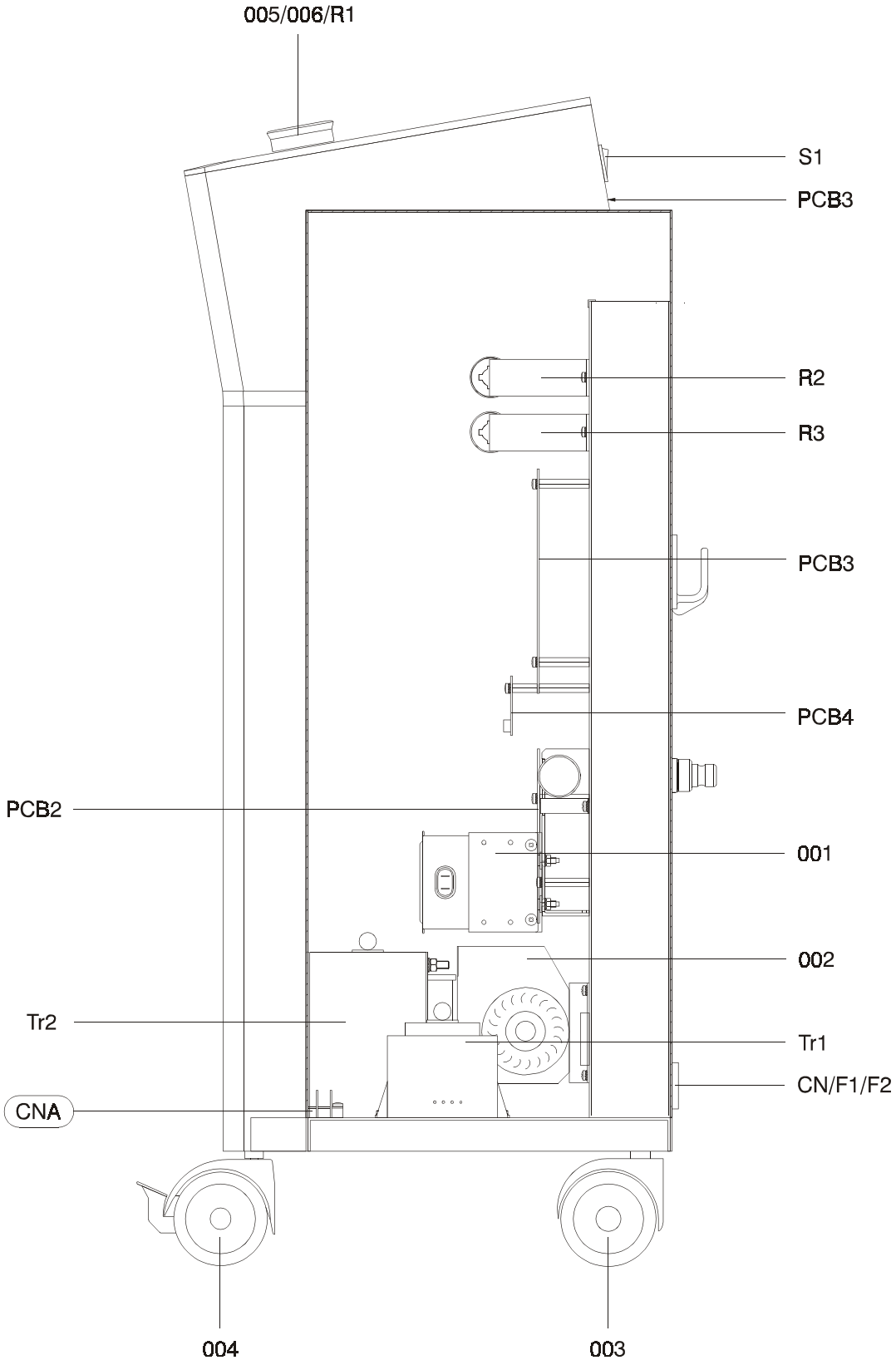


Figure 4 Chassis side view.

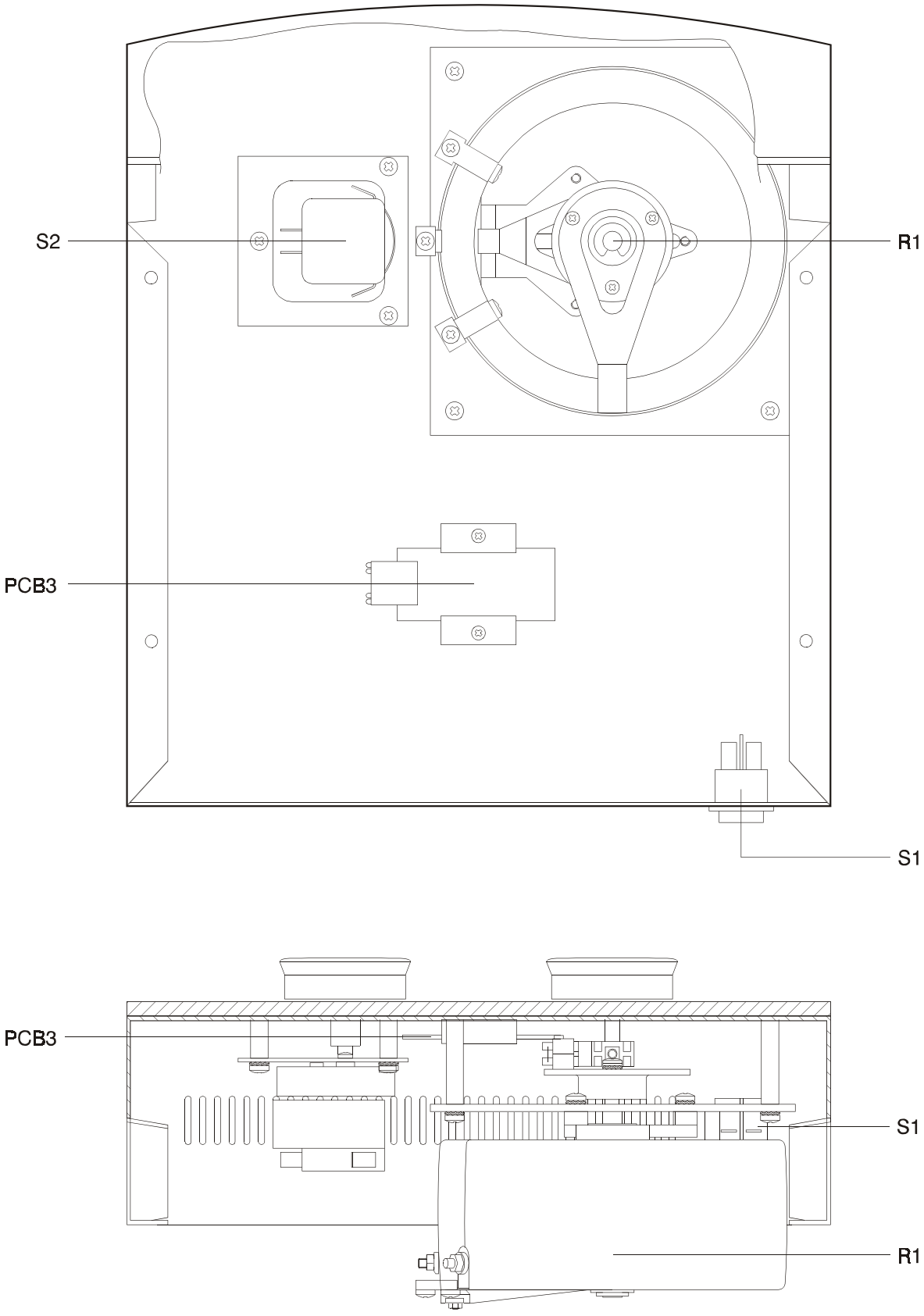
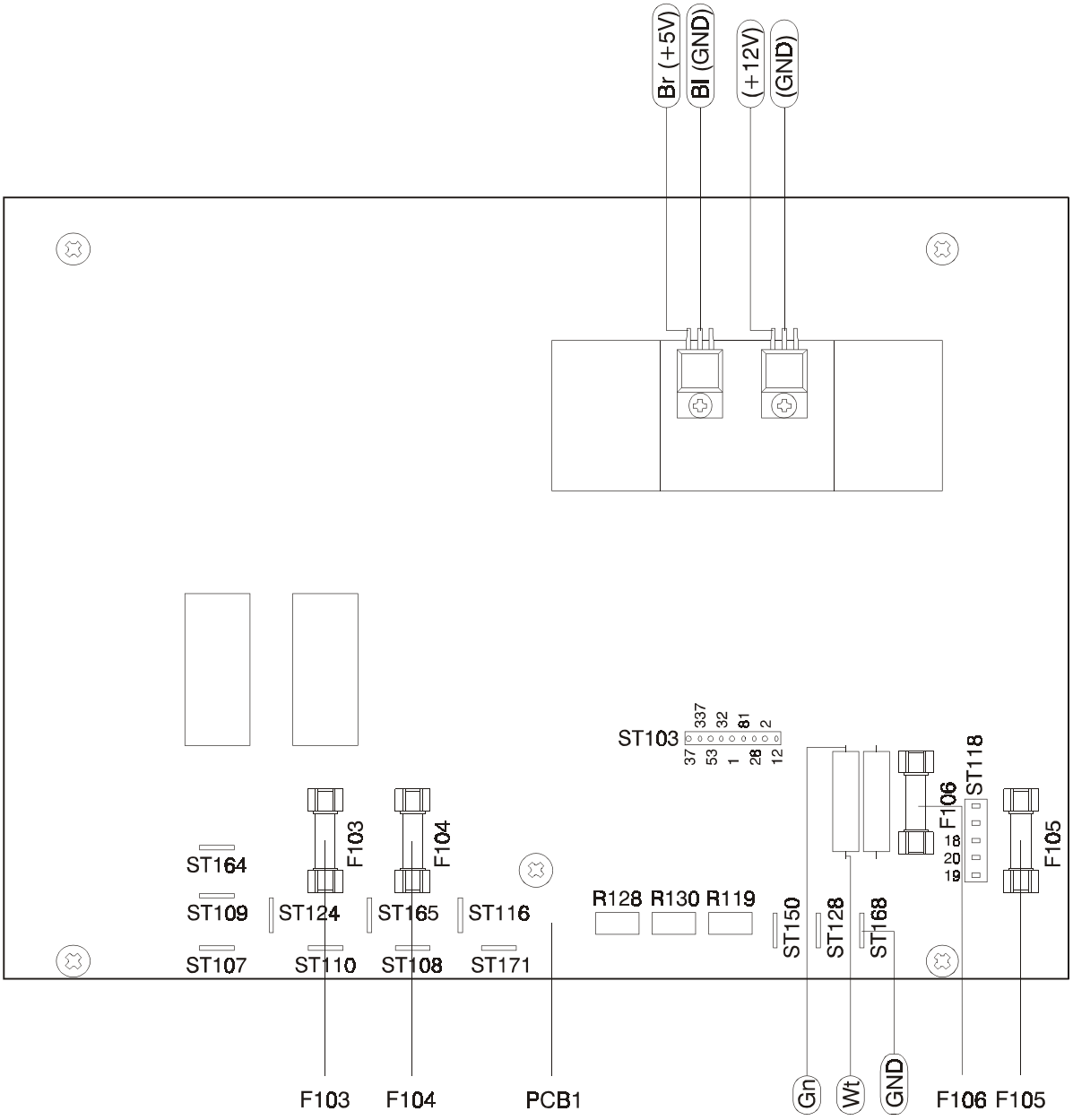


Figure 5 Top cover inside.



Conn:	ST103 1	ST103 2	ST103 12	ST103 28	ST103 32	ST103 37	ST103 53	ST103 81	ST103 337
Conn. with:	Zero switch (1)	Timer (2A)	Zero switch (2)	Timer (1A)	Therm. Switch (1)	Therm. Switch (2)	Not used	H.F. Filter (1)	Not used

Conn:	ST118 16	ST118 17	ST118 18	ST118 19	ST118 20
Conn. with:	Not used	Not used	TR1-10 [9.7V]	TR1-12 [9.7V]	TR1-11 [0 V]

Terminal:	ST107	ST108	ST109	ST110	ST116	ST124	ST128	ST150	ST164	ST165	ST168	ST171	+ 5V.	0 V.
To: Conn./ Location [Name]	CNA (3)	CNA (1)	FAN (1)	FAN (2)	R3 (2)	R1 (1)	TR2 (15) [0 V.]	PCB2 (CN12)	S1 (3)	S1 (4)	GND	TR2 (2)	PCB4 (7) [+5Volt]	PCB4 (6) [0 Volt]

Figure 6 Main PC Board.

PC Board specification

Product code: 3412319 PC Board, main

Description
Main module for Radarmed 650 units.

Layers (single/bi/multi): bi-layer

Product code(s)
3412319 Part no of complete assy (printed on label on PC Board)
N.A. Part no of PC Board only (printed on PC Board)
0409809 Equivalent service (spare part) part no (not printed on PC Board; used for ordering only)

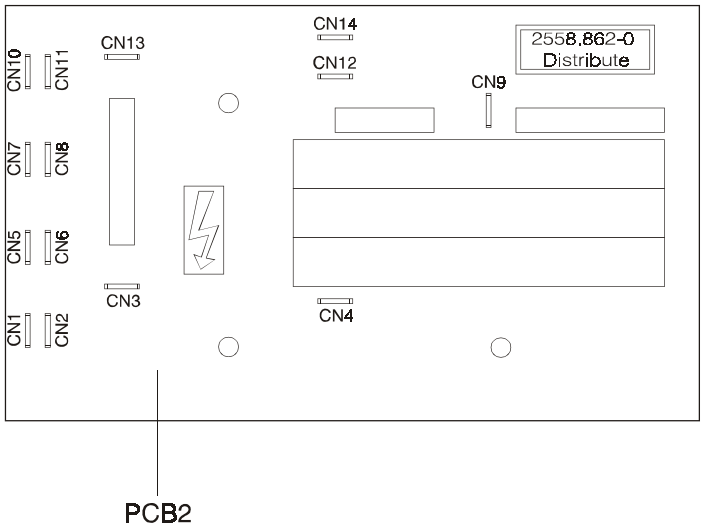
Software
NA

Service

Circuit adjustments:	No
Serviceable parts for FSE:	F103, F104, F105, F106
Repairable by manufacturer:	Yes

Application / compatibility
Can be used for Radarmed 650 units.

Notes



Terminal:	CN1	CN2	CN3	CN4	CN5	CN6	CN7	CN8	CN9	CN10	CN11	CN12	CN13	CN14
To: Conn./ Location:	TR2 (14) [1900VAC]	See adjust proced.	See adjust proced.	Mag-netron (2)	TR2 (13) [2000VAC]	See adjust proced.	TR2 (12) [0VAC]	See adjust proced.	C1 (1)	TR2 (11) [200VAC]	See adjust proced.	PCB1 ST150	C1 (2)	Not used

Figure 7 Distributor PC Board.

PC Board specification

Product code: 0409680 PC Board, distributor

Description
Distributor module for Radarmed 650 units.

Layers (single/bi/multi): bi-layer

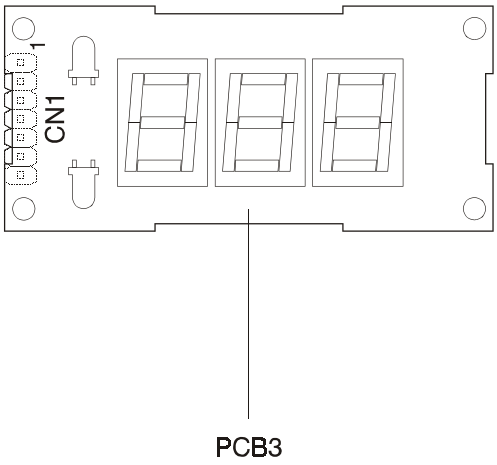
Product code(s)
0409680 Part no of complete assy (printed on label on PC Board)
N.A. Part no of PC Board only (printed on PC Board)
0409814 Equivalent service (spare part) part no (not printed on PC Board; used for ordering only)

Software
NA

Service
Circuit adjustments: No
Serviceable parts for FSE: N.A.
Repairable by manufacturer: No

Application / compatibility
Can be used for Radarmed 650 and Radarmed 950 units.

Notes



Connector:	CN1-1	CN1-2	CN1-3	CN1-4	CN1-5	CN1-6	CN1-7
Connected with:	PCB3 CN1-3	PCB3 CN1-4	Not used	Not used	Not used	PCB1 0 V.	PCB1 +5 V.

Figure 8 Display PC Board.

PC Board specification

Product code: 2611120 PC Board, display

Description
Display module for Radarmed 650 units.

Layers (single/bi/multi): bi-layer

Product code(s)
2611120 Part no of complete assy (printed on label on PC Board)
N.A. Part no of PC Board only (printed on PC Board)
2611120 Equivalent service (spare part) part no (not printed on PC Board; used for ordering only)

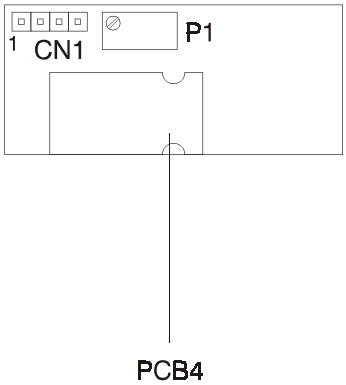
Software
NA

Service

Circuit adjustments:	No
Serviceable parts for FSE:	N.A.
Repairable by manufacturer:	No

Application / compatibility
Can be used for Radarmed 650 units.

Notes



Connector:	CN1-1	CN1-2	CN1-3	CN1-4
Connected with:	PCB1 R26-1	PCB1 R26-2	PCB4 CN1-1	PCB4 CN1-2

Figure 9 Display interface PC Board.

PC Board specification

Product code: 0409681 PC Board, display interface

Description
Display interface module for Radarmed 650 units.

Layers (single/bi/multi): single-layer

Product code(s)
0409681 Part no of complete assy (printed on label on PC Board)
N.A. Part no of PC Board only (printed on PC Board)
0409681 Equivalent service (spare part) part no (not printed on PC Board; used for ordering only)

Software
NA

Service

Circuit adjustments:	No
Serviceable parts for FSE:	N.A.
Repairable by manufacturer:	No

Application / compatibility
Can be used for Radarmed 650 units.

Notes

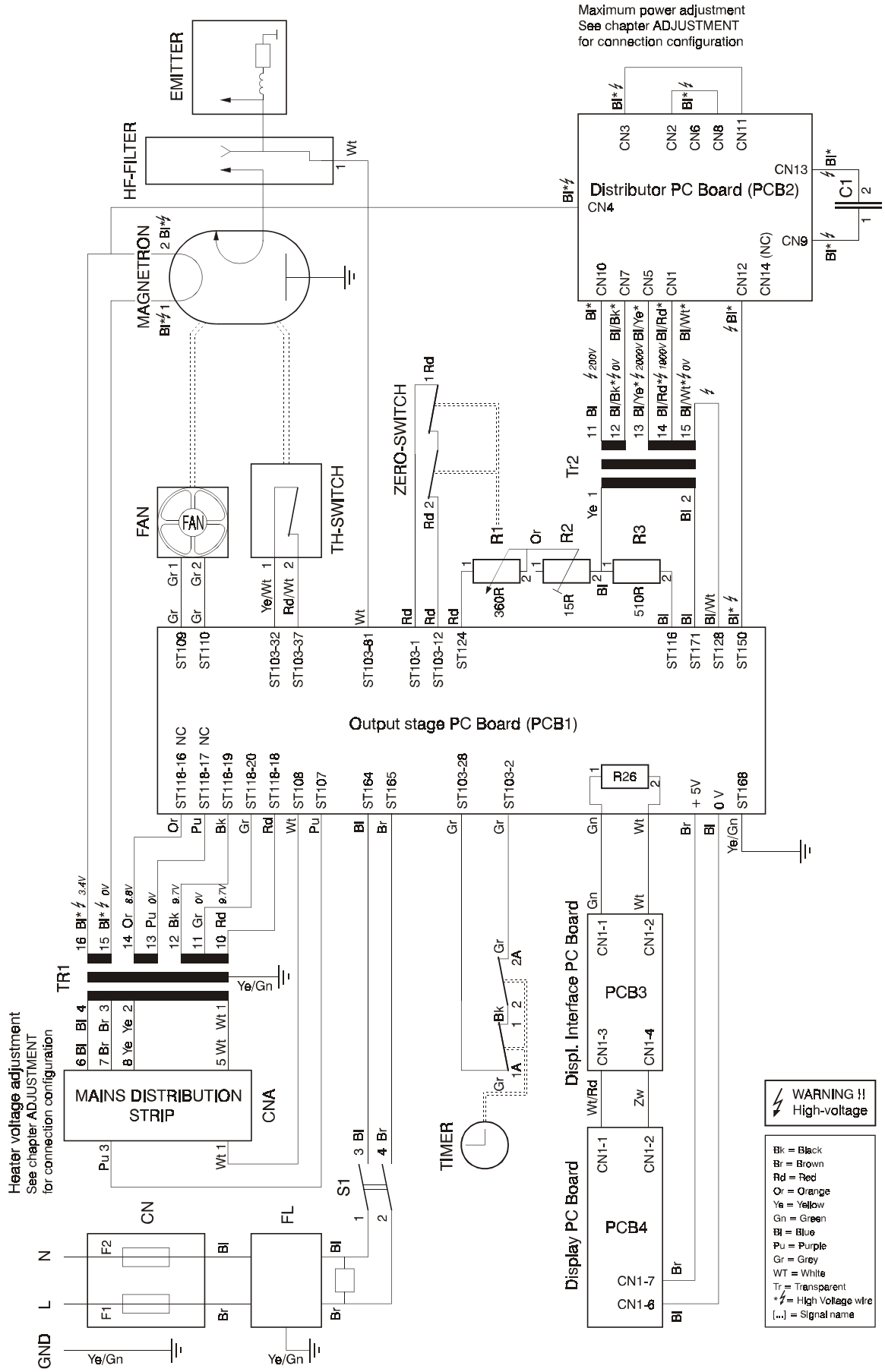


Figure 10 Wiring diagram.

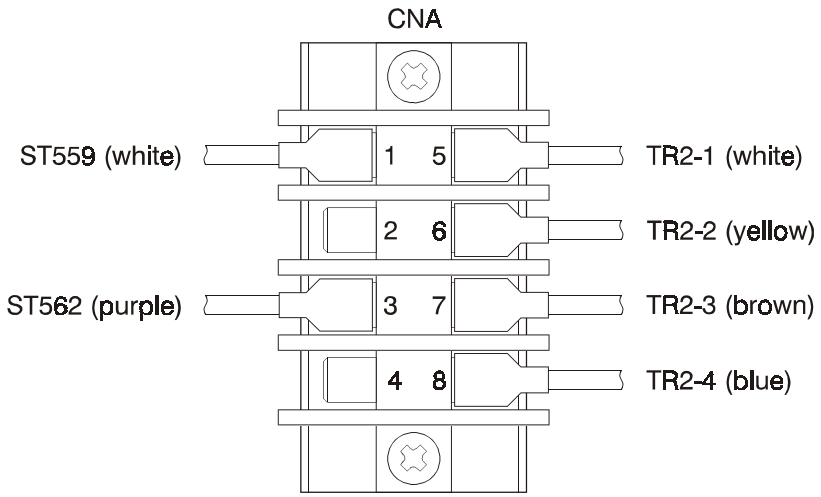


Figure 11 Mains distributor strip configuration.

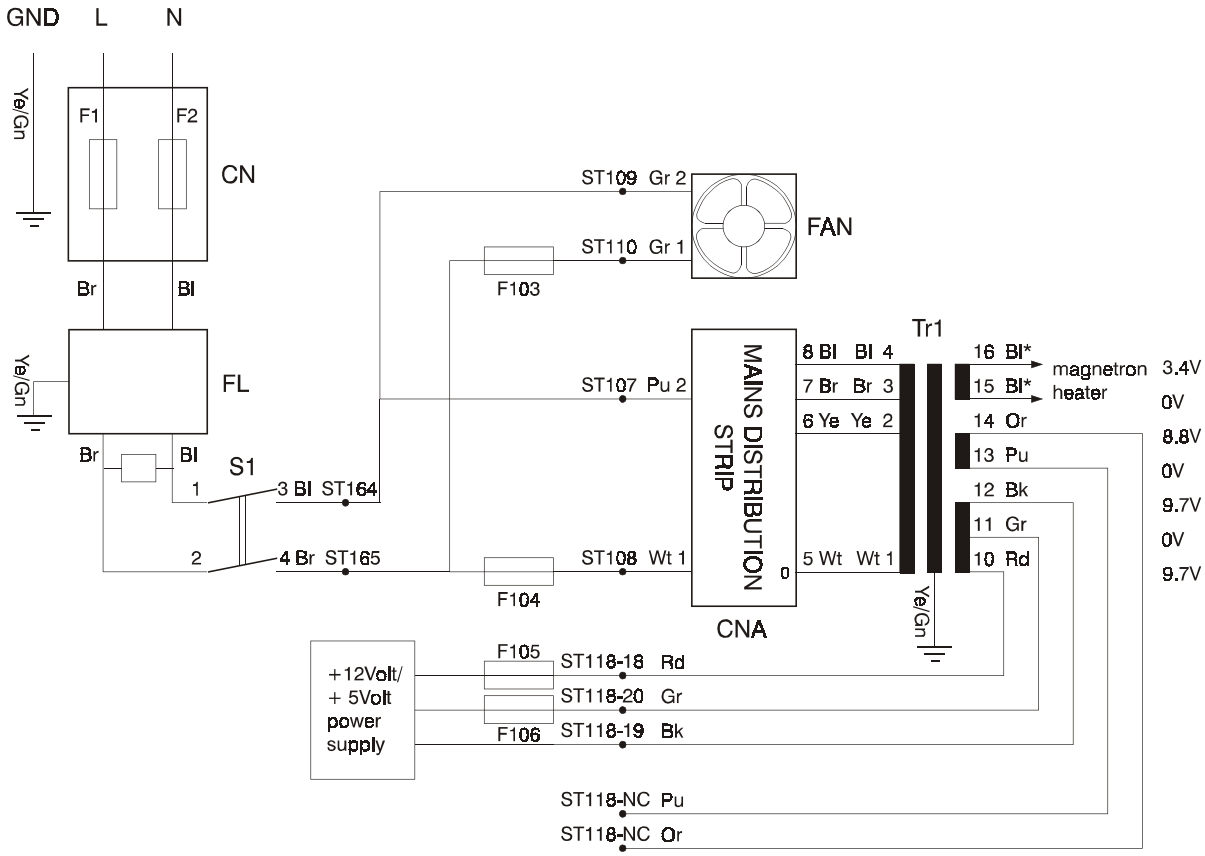


Figure 12 Power supply diagram.

APPENDIX C **SERVICE INFO'S (Product Change Notes)**

C.1 **GENERAL**

The technical information in the service manuals of Enraf-Nonius is up to date from the date of issue.

The necessary additional information (of any kind) will be provided in the following way:

- as supplements to the manual, or
- as revised editions (chapters) of the manual, or
- as Service Info's (product change notes).

Once every year Enraf-Nonius publishes a Service Info which lists all the published Service Info's until sofar.

Once every year Enraf-Nonius publishes a Service Info which lists all the published service manuals. Note that from that moment on these manuals contain all the published Service Info's until so far. The relevant technical information will then be bind in this appendix.

When a supplement or a revision is made to the manual, a "document history file" is added to this chapter. This file will give information about the date of issue of supplements or revisions.

C.2 Revision history

First edition: January 2000

Revisions:

Chapter:	Revision:	Date of issue:	page

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